PATENT ABSTRACTS OF JAPAN

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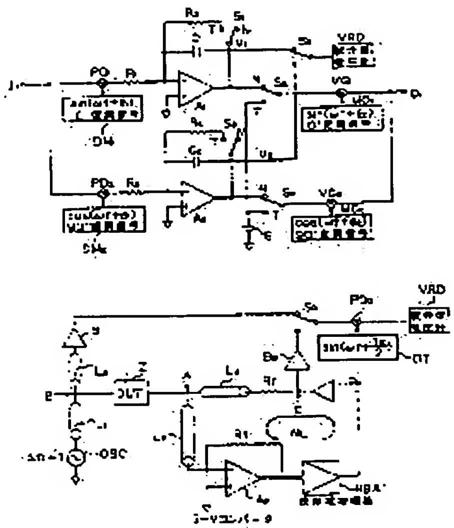
(54) ADAPTIVE TYPE HALF-BRIDGE AND IMPEDANCE METER

(57)Abstract:
PURPOSE: To prevent the oscillation of a null loop and the occurrence of unbalance of a bridge by opening the feedback loop of a feedback amplifier, detecting the phase rotation of the feedback loop, and controlling the phase rotation at a specified value.
CONSTITUTION: A terminal to be measured DUT has first and second terminals B and A. The first terminal B of the terminal to be measured DUT is driven through a cable L1 from a sine wave signal source OSC. Meanwhile, a feedback amplifier is connected to the second terminal A of the terminal to be measured DUT, and the second terminal A is made to be a virtual grounding part. The voltage flowing through the terminal to be measured DUT is converted into a voltage in the feedback amplifier. The output of the amplifier is inputted into a terminal I1 and further inputted into phase detectors PD1 and PD2. The detected output signals have the phase difference of 90° to each other. The signals have the same frequency as that of a signal source OSC. The detected outputs are integrated and amplified, and the DC components are inputted into modulators VG1 and VG2 of vector generators. As the inputs of the modulators VG1 and VG2, DC voltages are inputted. Therefore, the phase rotation of a feedback loop is detected, the phase rotation is controlled to a specified value and the balance of a bridge is established.



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CLAIMS

(57) [Claim(s)]
[Claim 1] The adapted type half bridge characterized by providing the following The 1st, the source of a measurement signal connected to the 1st terminal of the above of the measured element (Following DUT is called) which has the 2nd terminal Feedback amplifier which transforms into voltage the current which flows to Above DUT while connecting with the 2nd terminal of the above of Above DUT and carrying out the artificial ground of this 2nd terminal A means to open the feedback loop of the aforementioned feedback amplifier wide, and to detect round phase rotation of this feedback loop Control means which control the aforementioned round phase rotation to a predetermined value
[Claim 2] The adapted type half bridge according to claim 1 characterized by making the output of the aforementioned source of a measurement signal into zero at the time of detection of the aforementioned round phase rotation.
[Claim 3] The adapted type half bridge according to claim 1 which the aforementioned feedback amplifier is become [irregular] type amplifier, and is characterized by controlling the phase contrast of the modulating signal of this become [irregular] type amplifier, and a recovery signal by the aforementioned control means so that the aforementioned round phase rotation becomes the aforementioned predetermined value.
[Claim 4] It is the adapted type half bridge according to claim 3 characterized by performing detection of the aforementioned round phase rotation by opening between the modulator of the aforementioned become [irregular] type amplifier, and demodulators wide.
[Claim 5] While connecting with the source of a measurement signal connected to the 1st terminal of a measured element (Following DUT is called), and the 2nd terminal of Above DUT and carrying out the artificial ground of this 2nd terminal The vector voltmeter which measures the impedance of Above DUT from the feedback amplifier which transforms into voltage the current which flows to Above DUT, and the 1st of Above DUT, and 2nd voltage between terminals and the voltage by which conversion was carried out [aforementioned], ************, impedance meter characterized by round phase rotation of the aforementioned feedback amplifier being detected by the aforementioned vector voltmeter.

[Translation done.]

narrow band amplifier which constitutes a nulling loop, and the recovery section, and a round phase shift of a nulling loop is measured. From a measured round phase shift, the phase shift (positive and negative ****) of an addition required for the stability of a nulling loop is calculated. The phase shift of the calculated addition is realized by controlling the phase contrast of a modulating signal and a recovery signal.

<Example of invention> The narrow band amplifier NBA in a view 3, i.e., the portion equivalent to the circuit of the 4th view, consists of one example of this invention newly, and it becomes as shown in a view 1. In the view 1 and the view 4, the same reference number and the sign are given to the component part which has equivalent function and performance mutually.

The component parts newly added to the view 4 are switches S1, S2, and S3, S4 and resistance R3 and R4, and DC power supply E. Since the found the integral type voltmeter VRD is used for measurement of a round phase shift, it has indicated to the view 1. The found the integral type voltmeter VRD is the same also in a view 3, and can measure the ratio of input direct current voltage. Measurement of the input direct-current-voltage value itself is sometimes possible. Therefore, when an input direct-current-voltage ratio is equivalent to the real part and imaginary part of an alternating current with control / calculation equipment containing the microprocessor which is not illustrated, the phase angle of an alternating current is called for.

The above-mentioned example operates as follows. In order to acquire a test state first, switches S1, S2, and S3 and S4 are closed to each terminal T side. (In illustration, it is closing to Terminal N side). Others are the same as that of a measurement state, and DUT is connected. Each output of the source OSC of a sinusoidal signal, the source DM 1 of 0-degree recovery signal, the source DM 2 of 90-degree recovery signal, the source MO 1 of 0-degree modulating signal, and the source MO 2 of 90-degree modulating signal is the sinusoidal signal =0 or 0-degree recovery signal sin (wt+theta 1), 90-degree recovery signal cos (wt+theta 1), 0-degree modulating-signal sin- (wt+theta 2), and the 90-degree modulating signal cos Although all amplitude is assumed to be 1 here, the slight difference in an amplitude is unrelated to the main point of the invention in this application. Time, and theta1 and theta2 is [W of angular frequency and t] phase angles, and theta 1 is usually gill ****** to zero. Furthermore, non-sinusoidal waves, such as a square wave, are sufficient as these signals for a strange recovery. Usually, the object for prizes of the square wave signal is carried out. When these square wave signal has a small modulation product by the higher harmonic, it has the same effect as the sine wave which is a fundamental wave. In the nulling loop relevant to this invention, it is such, and even if it considers all to be a sine wave, it does not become the hindrance which understands the main point of this invention. Since the direct current voltage from DC power supply is inputted, an absolute amplitude is disregarded and, as for the input of modulators VG1 and VG2, sin (wt+theta2+pi/4) is outputted to an outgoing end 01. The signal sin (wt+theta 2+pi/4+thetax) by which the phase shift was carried out further in the external circuit returns to the input I1 of a narrow band amplifier NBA. theta x is the amount of phase shifts of an external circuit. It gets over by demodulators PD1 and PD2, smooth direct-current amplification is carried out, respectively, and this signal is outputted from amplifier A1 and A2. The output direct current voltage V1 of amplifier A1 is proportional to cos (theta2+pi / 4+theta x-theta 1).

If it chooses with R1=R2, R3=R4, and C1=C2 in order to simplify explanation

$$\frac{V_1}{V_2} = \tan(\theta_2 + \pi/4 + \theta_x - \theta_1) \qquad -(1)$$

It becomes.

Therefore, it is delta=theta 2+pi/4+theta x-theta 1=tan-1 (V1/V2) (radian) by the calculation equipment which is not illustrated. -(2)

**** ****.

In order for a nulling loop to operate stably, it is theta2+thetax-theta1=pi (radian). - (3)

What is necessary is just to come out.

Therefore, delta=pi/4+pi - (4)

What is necessary is just to adjust theta2-theta1 so that it may become.

Since an arc tangent function shows only the range of principal value that a formula (2) also shows, from a formula (4), it is-delta=pi/4. - (5)

It is adjusted so that it may become.

Therefore, generally in low frequency, theta x is almost pi, since theta x increases from pi along with elevation of frequency, when there is a possibility that theta x may change a lot, in the frequency of several points, delta may be measured from low frequency, and the true value of theta x may be calculated in approximation.

Or theta2-theta1 may be changed, and you may control automatically so that it may be made to converge on the value used as delta=pi/4. In this case, if there is a too big phase shift, in observation of only delta, theta2-theta1 cannot be determined as a meaning. In this case, V1 and V2 are measured separately, or the value of theta2-theta1 is determined temporarily, switches S1, S2, and S3 and S4 are closed to each terminal N side, and the existence of an oscillation of a nulling loop is checked, if there is no oscillation, it will consider as a correct answer, and if there is an oscillation using it, the procedure in which only pi makes theta2-theta1 small will be added.

If above-mentioned adjustment is completed and switches S1, S2, and S3 and S4 are closed to Terminal N side, respectively, in the impedance meter of the conventional technology shown in a view 3, it will operate similarly.

In addition, resistance R3 and R4 is for restricting the amplification degree of an integrator and enabling measurement of delta.

The example of a circuit for giving theta2-theta1 is shown in a view 2. In a view 2, it is for approximating necessary theta2-theta1 and setting up at a pi/8-radian (22.5 degrees) step.

In this circuit, when referred to as W=2pifn, the digital signal fm input of frequency fm and the clock signal 16fm clock of frequency 16fm are introduced from input terminals I2 and I3, respectively.

The signal inputted into I2 serves as an input of the 90-degree phase shift circuit IC 2 while serving as an output of the source DM 1 of a recovery signal as it is. The 90-degree phase shift circuit IC 2 shifts four beats of fm inputs with 16fm clock, and gives the output of the source DM 2 of a recovery signal.

the hexadecimal preset counter IC 1 — fm input — starting — while loading the data from a terminal I4, counting with 16fm clock and inputting 50% output of the duty ratio into the 90-degree phase shifter IC 3, the output of the source MO 1 of a modulating signal is given On the other hand, the 90-degree phase shifter IC 3 shifts four beats of the aforementioned input with 16fm clock, and gives the output of the source MD 2 of a modulating signal.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
<Technical field of invention> If this invention is stably possible in impedance measurement with especially wide band high degree of accuracy about the impedance meter using the half bridge and it containing feedback amplifier, it is related with the technology of closing.
<The conventional technology and its trouble> In precise measurement of electric element, the object for prizes of the half bridge type impedance meter using feedback amplifier is carried out. For example, 4261A marketed from YOKOGAWA ELECTRIC and Hewlett Packard Co. Many an LCR meter, 4275A multi-FURIKENSHI LCR meters, 4191A RF impedance analyzers, 4194A impedances / gain phase analyzers, etc. are marketed.
The outline circuit diagram showing the function of the impedance meter by the micro PUROSSESA control which is not illustrated to a view 3 is shown. You may have other terminals, although the measured element (Following DUT is called) Z is expressed as a 2 terminal element. For example, with 3 terminal element, in the 3rd terminal, bias is carried out and grounding or the property (for example, transfer IMMI wardrobe property) over the 1st remaining terminal and the 2nd remaining terminal is measured.
The terminal B of DUTZ is driven through a cable L1 from the source OSC of a sinusoidal signal (although you may have many sine waves, I think temporarily that one sine wave is generated).
The signal on Terminal B is inputted into a buffer B1 through a cable L2, and is supplied to Switch So. Other terminals A of DUTZ are connected to the inversed input terminal of Amplifier AG through a cable L3 so that artificial ground may be carried out. Terminal A is connected to one terminal of the criteria resistance Rr through a cable L4 again, and the other-end child C of the criteria resistance Rr is connected to Switch So through a buffer B3. Amplifier AG grounds the noninverting input terminal, and forms the current-voltage converter (I-V converter) which connected Resistance Rf with the inversed input terminal between outputs.
The output of a I-V converter is introduced into Terminal C through a narrow band amplifier NBA and buffer B-2. A cable L3, Amplifier AG, a narrow band amplifier NBA, buffer B-2, the criteria resistance Rr, and the cable L4 constitute the negative feedback loop, and call it especially a nulling loop (NL).
Ideally, a round phase shift (or rotation) of NL is 180 degrees (pi radian).
A view 4 is a detailed block diagram of the narrow band amplifier NBA of a view 3. In order to enlarge amplification degree of a narrow band amplifier NBA (for example, 180dB), become [irregular] type amplifier is used.
A I-V converter output is inputted into a terminal I1, and is inputted into phase discriminators PD1 and PD2. It is 0-degree recovery signal and 90-degree recovery signal, respectively, and the wave detector signal of phase discriminators PD1 and PD2 has the phase contrast of 90 degrees mutually, and are the signal of the source OSC of a signal, and a signal of the same frequency.
Integration amplification of the output of phase discriminators PD1 and PD2 is carried out by each integrator, and a dc component is inputted into the modulators VG1 and VG2 of each vector generator. A modulating signal is 0-degree modulating signal and 90-degree modulating signal which have 90-degree phase contrast mutually, and is supplied from the source MO 1 of 0-degree modulating signal, and the source MO 2 of 90-degree modulating signal, respectively.
In a view 4, an integrating amplifier consists of resistance R1, a capacitor C1, and DC amplifier A1 to a phase discriminator PD 1, and consists of resistance R2, a capacitor C2, and DC amplifier A2 to a phase discriminator PD 2.
0-degree recovery signal and 90-degree recovery signal are controlled, respectively, so that it is supplied from the source DM 1 of 0-degree recovery signal, and the source DM 2 of 90-degree recovery signal and only 0-degree modulating signal, 90-degree modulating signal, and theta have phase contrast, respectively. Therefore, the output to buffer B-2 adding the output of modulators VG1 and VG2 appears in an output terminal 01.
When each of 0-degree modulating signal, 90-degree modulating signal and 0-degree recovery signal, and 90-degree recovery signal carries out equality, is and considers as a size, the input signal to an input terminal I1 and the output signal from an output terminal 01 have phase contrast theta.
A view 3 is referred to once again. The output of buffers B1 and B3 is inputted into a phase discriminator PD 0 by turns with a switch S0, is detected with the rectangular signal generator DT, and is inputted into the found the integral type voltmeter VRD. The found the integral type voltmeter VRD carries out the orthogonal decomposition of the output of buffers B1 and B3, measures it, and measures the IMMI wardrobe of DUTZ further. Generally these are performed in the above-mentioned device. now, elevation of signal frequency, the increase in cable length, and change of a DUT IMMI wardrobe — a round phase shift of a nulling loop (NL) — changing — just — being alike — a nulling loop will become unstable Conventionally, to this problem, above-mentioned theta tended to be changed with signal frequency, and it was going to solve it.
Adjustment of theta was performed in software or in hardware, and the value of theta was defined experimentally.
However, as shown in a view 3, the cables L1, L2, L3, and L4 for external connection are contained in a nulling loop, and it has the gap from the ideal property of a I-V converter, and the influence of DUT, and Terminal A shifts from an artificial ground state. Moreover, when using a cable which is different from a standard cable in cables L1-L4, there were an unstable state and an unstable bird clapper similarly.
The <purpose of invention> Therefore, the purpose of this invention is realizing the half bridge and impedance meter which have the function which is adapted for a measurement state and stabilizes a nulling loop.

<Effect of the invention> The following effects are acquired by operation of this invention as explained in full detail above.
1) In the latest impedance meter which performs automatic ranging, it is lost that a nulling loop oscillates and the balance of a bridge cannot be taken by the difference in measurement conditions or DUT.
2) consequently, the former — like — works — setting — before shipment — proofreading — carrying out — each frequency and a side — a law — determine the amount of phase shifts according to a range, and it becomes unnecessary to write it in storage
3) Further, the amount of round phase shifts can be measured and the abnormalities of a nulling loop can be detected automatically.
4) If needed, as round phase contrast of a nulling loop is not pi about a modulating signal and the phase contrast between recovery signals, a special effect can be taken out.

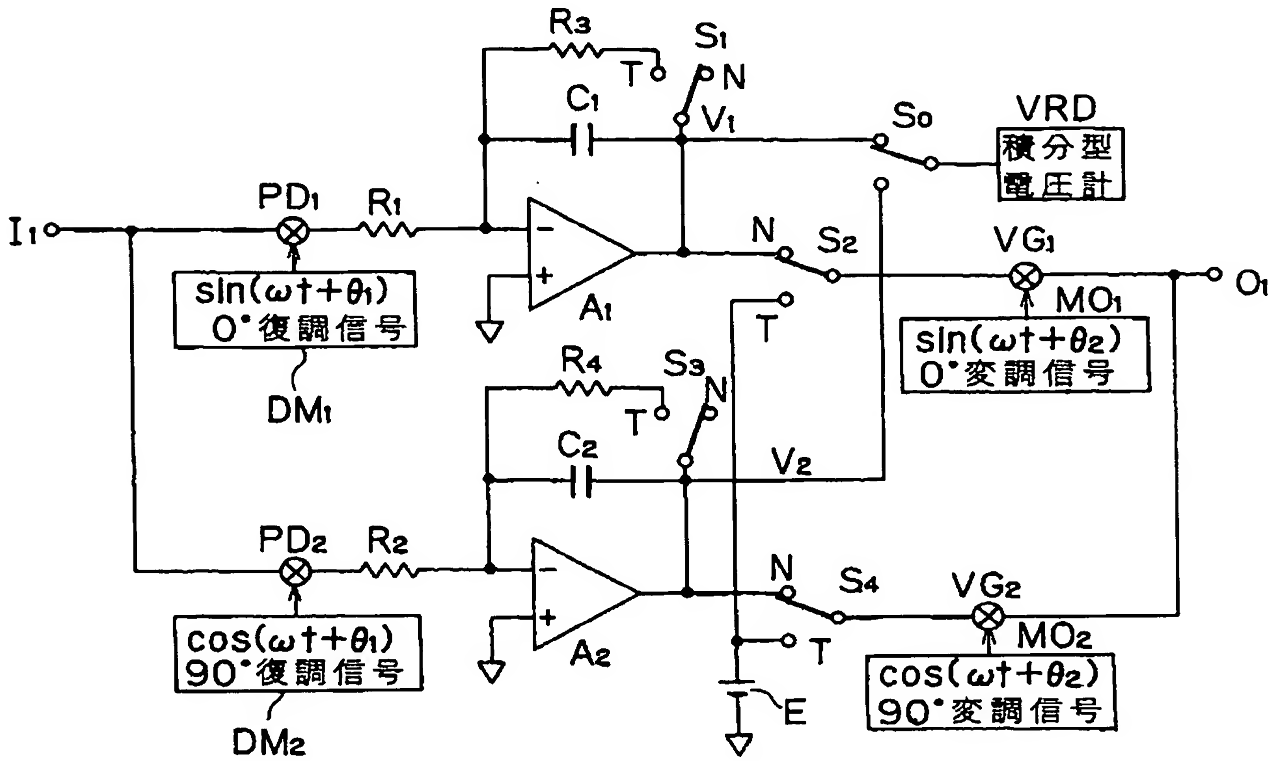
[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
A view 1 is an outline circuit diagram of the narrow band amplifier which is one portion of the nulling loop which performs the phase shift of the signal used for one example of this invention.
A view 2 is an outline circuit diagram of one example of the circuit for controlling the phase contrast between the modulating signal of a view 1, and a recovery signal.
A view 3 is an outline circuit diagram showing the function of the impedance meter by the conventional technology.
A view 4 is the narrow band amplifier of the conventional technology corresponding to the narrow band amplifier of a view 1.
Z: DUT (measured element)
OSC: The source of a sinusoidal signal
L1, L2, L3, the L4:cable B1, B-2, the B3:buffers S0, S1, S2, and S3, S4: (unipolar ****) Switch
A1, A2, A2: Amplifier
NBA= narrow band amplifier
NL= nulling loop
PD1, a PD2= phase discriminator
VG1, a VG2= modulator
The source of 1= 0 degree recovery signal of DMs
The source of 2= 90 degree recovery signal of DMs
The source of 1= 0 degree modulating signal of MO
The source of 2= 90 degree modulating signal of MO

[Translation done.]

Drawing selection Drawing 1



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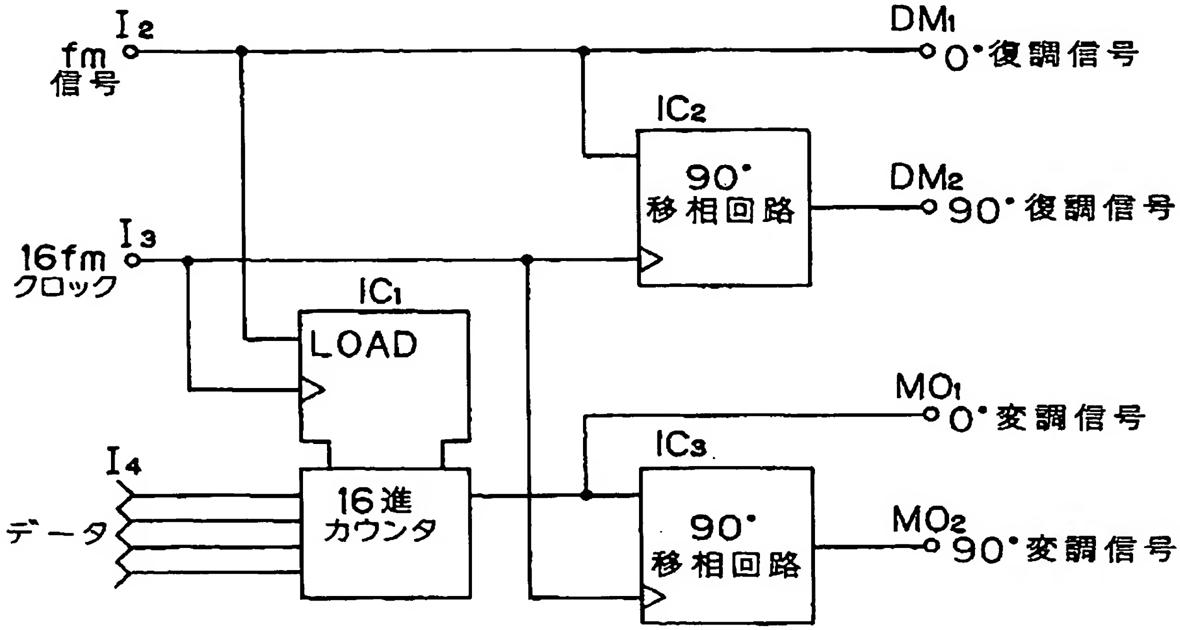
Drawing selection Drawing 2



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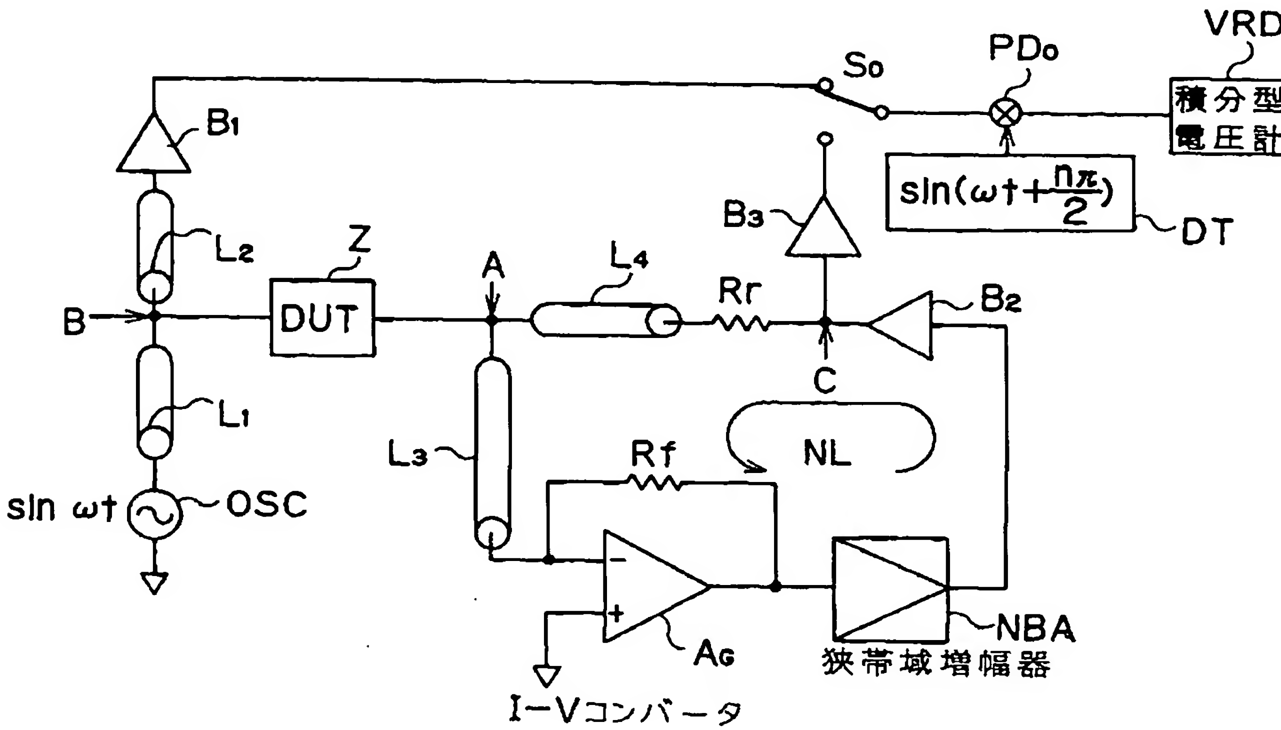
Drawing selection Drawing 3



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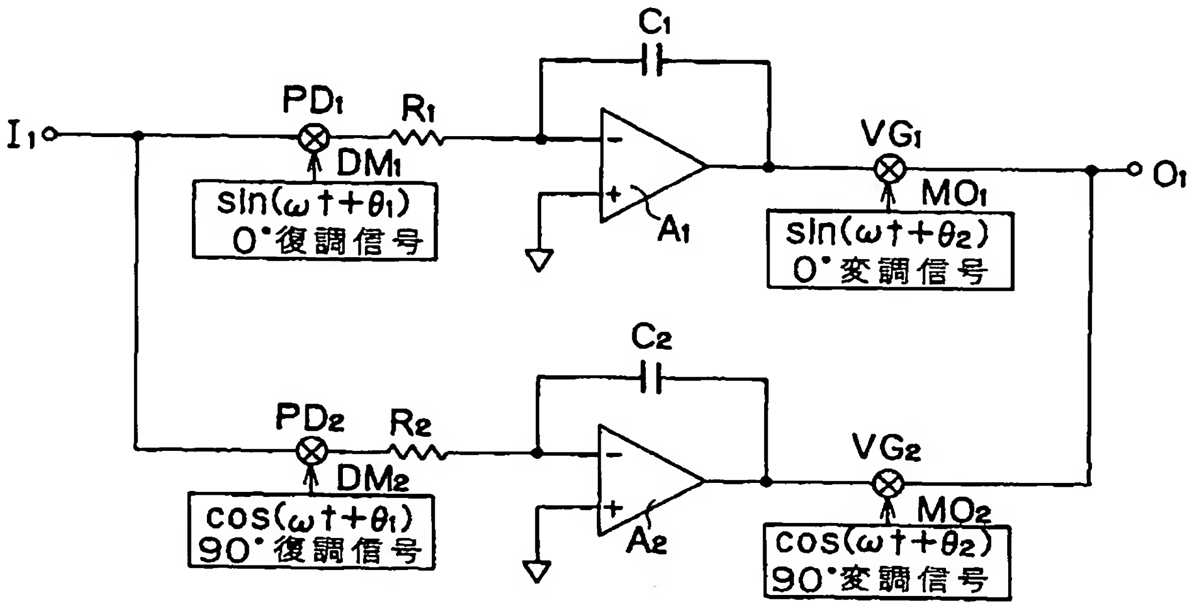
Drawing selection Drawing 4



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